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09/188,190	11/10/1998	KATSUNORI KANEKO	1472-177P	4015

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BIRCH STEWART KOLASCH & BIRCH
PO BOX 747
FALLS CHURCH, VA 22040-0747

EXAMINER	
NGUYEN, TU MINH	

ART UNIT	PAPER NUMBER
3748	19

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 09/188,190	Applicant(s) Kaneko et al.
	Examiner Tu M. Nguyen	Art Unit 3748

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136 (a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1) ☒ Responsive to communication(s) filed on *Dec 6, 2001*

2a) ☒ This action is **FINAL.** 2b) ☐ This action is non-final.

3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11; 453 O.G. 213.

Disposition of Claims

4) ☒ Claim(s) *1-14* is/are pending in the application.

4a) Of the above, claim(s) _____ is/are withdrawn from consideratio

5) ☐ Claim(s) _____ is/are allowed.

6) ☒ Claim(s) *1-14* is/are rejected.

7) ☐ Claim(s) _____ is/are objected to.

8) ☐ Claims _____ are subject to restriction and/or election requirement

Application Papers

9) ☐ The specification is objected to by the Examiner.

10) ☐ The drawing(s) filed on _____ is/are objected to by the Examiner.

11) ☒ The proposed drawing correction filed on *Aug 25, 2000* is: a) ☒ approved b) ☐ disapproved.

12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. § 119

13) ☒ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d).

a) ☒ All b) ☐ Some* c) ☐ None of:

1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

*See the attached detailed Office action for a list of the certified copies not received.

14) ☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

Attachment(s)

15) ☒ Notice of References Cited (PTO-892)

16) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

17) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s). _____

18) ☐ Interview Summary (PTO-413) Paper No(s). _____

19) ☐ Notice of Informal Patent Application (PTO-152)

20) ☐ Other:

DETAILED ACTION

1. An Applicant's Amendment filed on December 6, 2001 has been entered.

Claims 1 and 2 have been amended. Overall, claims 1-14 are pending in this application.

Claim Rejections - 35 USC § 112

2. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

3. Claims 5-7 are rejected under 35 U.S.C. 112, second paragraph, because claim 5 in Paper No. 7 recites the limitation "the three-way catalyst". There is insufficient antecedent basis for this limitation in the claim.

Claim Rejections - 35 USC § 102

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless --
>
> (e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.

5. Claims 1 and 8-14 are rejected under 35 U.S.C. 102(e) as being anticipated by Hepburn et al. (U.S. Patent 5,974,788).

Re claim 1, as shown in Figure 1, Hepburn et al. disclose an exhaust gas purifying apparatus of an internal combustion engine, comprising:

- exhaust gas purifying means (32), having a function of a three-way catalyst (the purifying means (32) of Hepburn removes HC, CO, and NO_x in the exhaust gas at stoichiometric or slightly rich condition (lines 13-18 of column 1)) provided in an exhaust passage of the internal combustion engine, for absorbing NO_x in an exhaust gas when an air-fuel ratio of the exhaust gas is lean, and means (20, 16) for releasing or reducing the absorbed NO_x when an oxygen concentration of the exhaust gas is reduced;

- a light-off catalyst (26) provided upstream of the exhaust gas purifying means in the exhaust passage, the light-off catalyst having a lower O_2 storage capability than the exhaust gas purifying means (lines 48-50 of column 4), the light-off catalyst and the exhaust gas purifying means are in an exhaust passage in series so that all the exhaust gas from the engine passes through both the light-off catalyst and the exhaust gas purifying means regardless of the engine operation modes; and

- control means (20) for controlling the air-fuel ratio of the exhaust gas so that an atmosphere having a reduced oxygen concentration is produced around the exhaust gas purifying means (32) when an NO_x conversion efficiency of the exhaust gas purifying means is decreased,

wherein a substance (SO_x) decreasing the NO_x conversion efficiency of the exhaust gas purifying means is released during the operation of the control means and is converted by the function of the three-way catalyst of the exhaust gas purifying means.

During a lean mode in the apparatus of Hepburn et al., in addition to NO_x, SO_x also accumulates in the exhaust gas purifying means (32) in the form of a sulfate, occupying the storage sites that would be otherwise used to store the nitrates of NO_x. This clearly causes a reduction in NO_x conversion efficiency of the purifying means (32). Thus, to restore the NO_x conversion efficiency of the purifying means, the sulfates stored in the purifying means (32) are occasionally purged and reduced by modulating the amplitude of the air-fuel ratio at a properly chosen frequency to create a rich break-through of the light-off catalyst. In this way, an atmosphere having large unburned HC and CO concentration is produced around the exhaust gas purifying means for the effective purging and reduction of the sulfates.

The mechanism of purging and reduction of sulfates stored in the purifying means is similar to the three-way catalytic reduction of nitrates. The only apparent difference is the higher temperature required for the sulfate purging. During the purging and reduction of sulfates, the exhaust gas entering the purifying means is enriched with unburned HC and CO. The oxidation of some of HC and CO with oxygen raises the temperature of the purifying means to at least 650°C, causing the release of the sulfates from the storage sites in the purifying means, which are then reduced by an endothermic reaction with the rest of HC and CO to form harmless substances which are then released to the environment.

Re claim 8, in the exhaust gas purifying apparatus of Hepburn et al., the internal combustion engine is a spark ignition type four-cycle engine that operates on the four-stroke cycle consisting of a suction stroke, compression stroke, combustion/expansion stroke, and exhaust stroke.

Re claim 9, in the exhaust gas purifying apparatus of Hepburn et al., the internal combustion engine is an in-cylinder injection type engine in which fuel is directly injected into a combustion chamber (lines 3-6 of column 2).

Re claims 10 and 11, the single catalyst of the exhaust gas purifying means (32) in the exhaust gas purifying apparatus of Hepburn et al. functions as a three-way catalyst.

Re claim 12, the light-off catalyst (26) in the exhaust gas purifying apparatus of Hepburn et al. includes a single catalyst that functions as a three-way catalyst (lines 12-13 of column 2).

Re claim 13, the exhaust gas purifying means (32) in the exhaust gas purifying apparatus of Hepburn et al. functions also as an NO_x catalyst.

Re claim 14, being exposed to high temperature exhaust gas, the light-off catalyst (26) in the exhaust gas purifying apparatus of Hepburn et al. also functions as a SO_x catalyst.

Claim Rejections - 35 USC § 103

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

7. Claims 3 and 4 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hepburn et al. as applied to claim 1 above, in view of design choice.

The exhaust gas purifying apparatus of Hepburn et al. discloses the invention as cited above, however, fails to disclose that an amount of oxygen absorbed on the light-off catalyst is not greater than about 150 cc per one-liter volume of the catalyst when measured by an oxygen pulse method and that an oxygen component stored in the light-off catalyst is not greater than about 25 gr per one-liter volume of the catalyst.

One having ordinary skill in the art of exhaust emission control would have recognized that the specification of the maximum volumetric or weighted amount of oxygen absorbed in a light-off catalyst would be a function of many variables such as the size of the light-off catalyst, engine size, engine operating conditions (load, speed, etc), air and fuel properties, capacity and size of a main catalyst, etc. Moreover, there is nothing in the record which establishes that the claimed maximum volumetric or weighted amount of oxygen absorbed in a light-off catalyst

presents a novel of unexpected result (See *In re Kuhle*, 526 F.2d 553, 188 USPQ 7 (CCPA 1975)).

8. Claim 2 and, as best understood, claim 5 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hepburn et al. in view of Takeshima (U.S. Patent 5,448,887).

Re claim 2, as shown in Figure 1, Hepburn et al. disclose an exhaust gas purifying apparatus of an internal combustion engine, comprising:

- exhaust gas purifying means (32), provided in an exhaust passage of the internal combustion engine, for absorbing NO_x in an exhaust gas when an air-fuel ratio of the exhaust gas is lean, and means (20, 16) for releasing or reducing the absorbed NO_x when an oxygen concentration of the exhaust gas is reduced;

- a light-off catalyst (26) provided upstream of the exhaust gas purifying means in the exhaust passage, the light-off catalyst having a lower O_2 storage capability than the exhaust gas purifying means (lines 48-50 of column 4), the light-off catalyst and the exhaust gas purifying means are in an exhaust passage in series so that all the exhaust gas from the engine passes through both the light-off catalyst and the exhaust gas purifying means regardless of the engine operation modes; and

- control means (20) for controlling the air-fuel ratio of the exhaust gas so that an atmosphere having a reduced oxygen concentration is produced around the exhaust gas purifying means (32) when an NO_x conversion efficiency of the exhaust gas purifying means is decreased,

wherein a substance (SO_x) decreasing the NO_x conversion efficiency of the exhaust gas purifying means is released from the exhaust gas purifying means during the operation of the control means by CO break-through in the light-off catalyst (lines 39-48 of column 1).

During a lean mode in the apparatus of Hepburn et al., in addition to NO_x, SO_x also accumulates in the exhaust gas purifying means (32) in the form of a sulfate, occupying the storage sites that would be otherwise used to store the nitrates of NO_x. This clearly causes a reduction in NO_x conversion efficiency of the purifying means (32). Thus, to restore the NO_x conversion efficiency of the purifying means, the sulfates stored in the purifying means (32) are occasionally purged and reduced by modulating the amplitude of the air-fuel ratio at a properly chosen frequency to create a rich break-through of the light-off catalyst. In this way, an atmosphere having large unburned HC and CO concentration is produced around the exhaust gas purifying means for the effective purging and reduction of the sulfates.

Hepburn et al., however, fail to disclose that the light-off catalyst has a constant HC conversion efficiency.

As shown in Figures 1 and 2, Takeshima teaches that the HC conversion efficiency for an upstream three-way catalyst (12) is relatively high and constant for an exhaust gas with a stoichiometric or fuel lean air-fuel ratio. The HC conversion efficiency, however, is relatively low and also constant for an exhaust gas with a fuel rich air-fuel ratio. It would have been obvious to one having ordinary skill in the art at the time of the invention was made, to have utilized the

teachings of Takeshima in the apparatus of Hepburn et al., since the use thereof would have provided a means to control the engine air-fuel ratio for the effective purifying of exhaust gas.

Re claim 5, the exhaust gas purifying means (32) in the modified apparatus of Hepburn et al. has an oxygen storage greater than that of the light-off catalyst (26) (lines 48-50 of column 4).

9. Claims 6 and 7 are, as best understood, rejected under 35 U.S.C. 103(a) as being unpatentable over Hepburn et al. in view of Takeshima as applied to claim 5 above, and further in view of design choice.

The modified exhaust gas purifying apparatus of Hepburn et al. discloses the invention as cited above, however, fails to disclose that an amount of oxygen absorbed on the light-off catalyst is not greater than about 150 cc per one-liter volume of the catalyst when measured by an oxygen pulse method and that an oxygen component stored in the light-off catalyst is not greater than about 25 gr per one-liter volume of the catalyst.

One having ordinary skill in the art of exhaust emission control would have recognized that the specification of the maximum volumetric or weighted amount of oxygen absorbed in a light-off catalyst would be a function of many variables such as the size of the light-off catalyst, engine size, engine operating conditions (load, speed, etc), air and fuel properties, capacity and size of a main catalyst, etc. Moreover, there is nothing in the record which establishes that the claimed maximum volumetric or weighted amount of oxygen absorbed in a light-off catalyst presents a novel of unexpected result (See *In re Kuhle*, 526 F.2d 553, 188 USPQ 7 (CCPA 1975)).

Response to Arguments

10. Applicant's arguments with respect to the references applied in the previous Office Action have been fully considered but they are not persuasive.

In response to applicant's argument that the purifying means (32) in Hepburn et al. does not have a function of a three-way catalyst (page 5 of Applicant's Amendment), the examiner fully disagrees. This function in the purifying means of Hepburn et al. can be explained as follows. The purifying means (32) of Hepburn et al. stores the NOx from the exhaust gas during a fuel lean operation in the form of nitrates; and releases and reduces the stored nitrates during a stoichiometric or fuel rich operation (lines 13-18 of column 1). The mechanism of the latter operation is very well understood for those with ordinary skill in the art. Some of the unburned HC and CO in the exhaust gas are oxidized with oxygen by the catalytic material (noble metal) to release heat, raising the temperature of the purifying means to at least 300°C. The high temperature causes the stored nitrates in the purifying means to be released, which are then reduced by an endothermic reaction with the rest of the unburned HC and CO to form water, nitrogen, and carbon dioxide. This mechanism ensures the destruction of all three harmful components, namely, HC, CO, and NO_x in the exhaust gas. Therefore, the purifying means of Hepburn et al. clearly has the function of a three-way catalyst.

In response to applicant's argument that it is improper to use "design choice" in the 103(a) rejections of dependent claims 3, 4, 6, and 7 (pages 7 and 8 of Applicant's Amendment), the examiner again fully disagrees. As has been clearly shown, the upstream light-off catalyst in

Hepburn et al. has a lower oxygen storage capacity than that of the downstream purifying means, which satisfies an important limitation in the pending application. Clearly, Hepburn et al. know the exact oxygen storage capacity of each of the light-off catalyst and the purifying means. Given the required and fixed (emphasis added) oxygen storage capacity of the light-off catalyst, it is obvious to those with ordinary skill in the art that the limitation of "the specified volumetric or mass of oxygen storage per unit volume of the catalyst" (emphasis added) is merely a design choice which is clearly a function of the size of the light-off catalyst. Since the oxygen storage capacity of the upstream light-off catalyst has to be constant, the specified volumetric or mass of oxygen storage per unit volume for a smaller catalyst should obviously be greater than those for a larger catalyst.

Conclusion

11. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Prior Art

12. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure and consists of two patents.

- Katoh et al. (U.S. Patent 5,402,641) disclose an exhaust gas purification apparatus for an internal combustion engine. From Figures 4, Katoh et al. further disclose a mechanism of storing and purging of sulfates in a trap.

- Goto et al. (U.S. Patent 5,472,673) disclose an exhaust gas purification apparatus for an internal combustion engine, which includes a SO_x trap located upstream of a NO_x absorbent.

Communication

13. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Examiner Tu Nguyen whose telephone number is (703) 308-2833.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Mr. Thomas E. Denion, can be reached on (703) 308-2623. The fax phone number for this group is (703) 308-7763.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Group receptionist whose telephone number is (703) 308-1148.

Tu M. Nguyen

TMN

December 14, 2001

Tu M. Nguyen

Patent Examiner

Art Unit 3748

Thomas Denion

THOMAS DENION
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 3700